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OPTICAL FIBER CLEAVER

DISPOSITIF DE CLIVAGE DE FIBRES

OPTIQUES

(54)

(57) Abstract:

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A device for cleaving optical fibers is provided. The device includes a housing assembly having an opening therein for receiving an optical fiber to be cleaved, and housing bending and cutting means which are reciprocally moveable in a direction transversely and substantially perpendicularly to the longitudinal axis of an optical fiber inserted into and through the opening into the housing. The housing assembly optionally has a removably connected receptacle for receiving the cut ends of a plurality of cleaved fibers.

L'invention concerne un dispositif permettant de cliver des fibres optiques. Ce dispositif comprend un boîtier dans lequel est ménagée une ouverture pour recevoir une fibre optique à cliver. Ce dispositif comporte également des moyens de cintrage et de coupe qui peuvent se déplacer selon un mouvement alternatif et dans un sens transversal et sensiblement perpendiculaire par rapport à l'axe longitudinal d'une fibre optique insérée dans le boîtier, par l'intermédiaire de l'ouverture. L'ensemble formant boîtier est relié de manière amovible à un réceptacle pour recevoir les extrémités coupées de

plusieurs fibres clivables.

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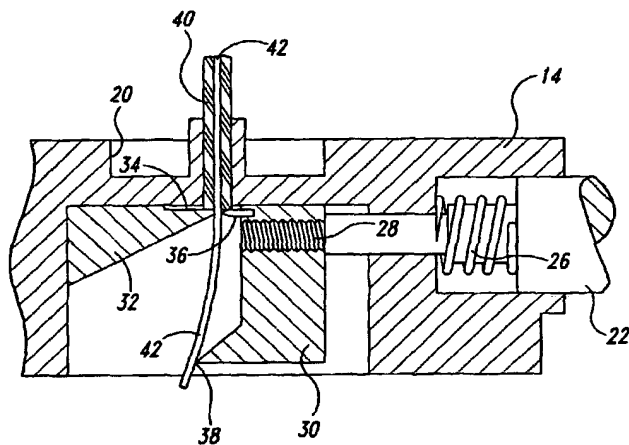
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(54) Title: OPTICAL FIBER CLEAVER



(57) Abstract: A device for cleaving optical fibers is provided. The device includes a housing assembly having an opening therein for receiving an optical fiber to be cleaved, and housing bending and cutting means which are reciprocally moveable in a direction transversely and substantially perpendicularly to the longitudinal axis of an optical fiber inserted into and through the opening into the housing. The housing assembly optionally has a removably connected receptacle for receiving the cut ends of a plurality of cleaved fibers.

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명세서

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## OPTICAL FIBER CLEAVER

## BACKGROUND OF THE INVENTION

The invention relates to methods and tools for cleaving optical fibers.

Optical fibers are used increasingly frequently in waveguides and in  
5 communications systems, generally, wherein light energy is transmitted through very  
long distances within optical fibers with little or no concomitant energy losses. Devices  
using optical fibers often must be coupled, and such coupling requires the severance of  
and the reconnecting thereof of the transmitting fibers, which are made, generally, of  
glass. Loss of light energy at a coupling is detrimental to most transmissions and is to  
10 be avoided.

A junction between light fibers should be as near-perfect as possible;  
that is, the glass-to-glass interface should abut precisely one fiber to another, to  
minimize energy losses and signal imperfections at these junctures. To accomplish  
precise joining, a precision cleaving tool must be employed.

15 Miles of optical fibers are installed "in the field", that is, removed from  
precision instrumentation. Various cleaving tools have been devised for field use,  
which provide various degrees of acceptability for the cleaved joint and for ease of  
operation, which also is of paramount importance in field use. Repeatability and  
consistency in cleavage are important considerations for any field tool.

20 It is well known that an optical fiber which is bent and then scribed or  
nicked will break at the scribe as a result of the variation in tensile stress across the  
cross-section of the fiber created by the bend. The break will generally be brittle and  
leave only slight imperfections across the fiber cross-section which can be removed by  
polishing, to produce an acceptable, virtually imperfection-free surface and subsequent  
25 joint.

An example of a known scribe-and-break tool for field use is found in  
U.S. Patent 5,301,868. That patent discloses a scribe-and-break tool for fracturing the  
free end of an optical fiber said to be suitable for hand-holdable configurations and field  
use. The tool has an elongated body and a plunger that actuates a blade for scribing the

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free end of an optical fiber retained in tension within a depressible head that extends outwardly from the body. The free end of the optical fiber contacts the blade, thereby scribing the free end of the fiber causing the free end to break off.

See also the patents referred to and distinguished in U.S. 5,301,868; especially U.S. 5,063,672 which discloses an alternative hand held tool for scoring and severing an optical fiber and is said to be suitable for field use.

#### SUMMARY OF THE INVENTION

A device for cleaving optical fibers is provided. The device includes a housing assembly having an opening therein for receiving an optical fiber to be cleaved, and housing bending and cutting means which are reciprocally moveable in a direction transversely and substantially perpendicularly to the longitudinal axis of an optical fiber inserted into and through the opening into the housing. The housing assembly optionally has a removably connected receptacle for receiving the cut ends of a plurality of cleaved fibers. Upon insertion of an optical fiber through the opening and into the housing, and upon actuation of the bending and cutting means, the fiber is sequentially bent and cleaved and the cut free end is collected in the receptacle.

In operation, preferably the fiber is sheathed within an insulating ceramic ferrule such that the fiber extends outwardly from the ferrule exposing a free end thereof, and the opening in the housing has a diameter large enough to receive the ferrule. The housing includes therein positioning means disposed in close proximity to the opening, which positioning means prevent the fiber/ferrule assembly from insertion into the housing beyond the positioning means, with the sequential bending and cutting means located within the housing so as to provide bending and cutting leaving a predetermined, exposed short length of fiber extending beyond the ferrule after the cleaving operation.

The positioning means may be a stop extending partially over the opening in the housing providing a shoulder within the housing upon which the ferrule rests. The shoulder is positioned at a predetermined depth externally from the opening

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and internally into the housing, beyond which shoulder the ferrule is prevented from further insertion.

Preferably the cleaving device has sequential bending and cutting means including a boot-shaped pushing head mechanism having an apex or toe and having  
5 affixed thereto a cutter, the pushing head being operable to move reciprocally within the housing and adjacent the opening in the direction transversely and substantially perpendicularly to a fiber inserted into and through the opening. The boot toe and cutter are positioned apart from one another along the fiber axis such that, upon movement of the boot toward the fiber, the toe pushes upon and bends the fiber in  
10 advance of the cutter contacting and cutting the fiber. The cutter is affixed to the boot such that the cutter contacts and cuts the fiber at a predetermined depth externally from the opening into the housing.

The cutting means is preferably a diamond knife.

The pushing head mechanism is operable by means including a spring-  
15 loaded plunger and connecting rod affixed thereto, the plunger being reciprocatingly mounted within a cylinder in a side wall of the housing. In field use, the pushing head is manually operable, in its simplest form by the thumb action of an operator pushing upon the plunger.

The housing assembly and receptacle may be fabricated of aluminum or  
20 other metal or another suitable material such as a plastic, e.g. a polycarbonate or a nylon. A preferred material is a glass-filled polycarbonate.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is an overall perspective view of the optical fiber cleaver of the  
25 invention, including the receptacle affixed to the bending and cutting housing;

Fig. 2 is a cross-sectional view of the fiber cleaver of the invention taken substantially along line 2-2 of Fig. 6, with the optional receptacle included for completeness.

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Fig. 3 is a cross-sectional view of the housing assembly containing the bending and cutting means of a preferred embodiment of the invention and showing the free end of a ferrule-encased optical fiber inserted into the opening in the housing prior to bending and cutting.

5 Fig. 4 is a cross-sectional view of the housing assembly showing an intermediate configuration of the bending and cutting apparatus and wherein the fiber is bent but not yet cut.

Fig. 5 is a cross-sectional view of the housing assembly showing the disposition of the bending and cutting apparatus at the completion of cleaving the fiber.

10 Fig. 6 is a bottom plan view of the housing assembly and the bending and cutting apparatus, partially broken away, according to a preferred embodiment of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION AND PREFERRED EMBODIMENT

15 A device for cleaving optical fibers is provided. The device includes a housing assembly having an opening therein for receiving an optical fiber to be cleaved, and housing bending and cutting means which are reciprocally moveable in a direction transversely and substantially perpendicularly to the longitudinal axis of an optical fiber inserted into and through the opening into the housing. The housing assembly  
20 optionally has a removably connected receptacle for receiving the cut ends of a plurality of cleaved fibers.

A detailed description of the invention and preferred embodiments is best provided by reference to the accompanying drawings wherein Fig. 1 is an overall perspective view of the cleaver apparatus 10 comprising an upper housing assembly 14  
25 having port 16 into which is inserted a fiber to be cleaved and having affixed thereto the optional collecting receptacle 12 for collecting the cut-off ends of cleaved fibers. Plunger or push button 22 will be described in detail below.

The housing assembly 14 is shown in greater detail in its bottom plan view of Fig. 6 and in Fig. 2, which is a cross-section of the housing taken along line 2-2

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of Fig. 6. Fig. 2 depicts port 16 having inside opening 18 and annular recess 20 machined into housing 14, which may be aluminum or other suitable material. Housing 14 is shown with optional receptacle 12, which may also be aluminum, affixed thereto, by friction fit. Receptacle 12 could be affixed by threads or other suitable connection means. In close proximity to the end of opening 18 where it opens into housing 14, and positioned at a predetermined depth from the opening, is shoulder or stop 34, cast or machined into support 32, this shoulder extending as shown, partially occluding the opening 18 into housing 14, for purposes which will become apparent in the description below.

10                   Positioned diametrically across from support 32, as depicted in Figs. 2 and 6, are the bending and cutting means which act upon an optical fiber to be cleaved. These bending and cutting means include the boot-shaped pushing head 30, with toe or apex 38 at its lower end and having affixed thereto, at its upper end and in close proximity to the exit of opening 18, a cutting blade, preferably a diamond knife blade, 15 36. Movement of the bending and cutting push boot assembly 30 is actuated by means of connecting rod 28, threaded as shown into boot 30, and connecting boot 30 to push button or plunger 22 which, upon pushing in the direction of the arrow shown, actuates the boot and blade 36 toward the opening 18. Spring 26 is provided for plunger 22 and is positioned within cylinder 24 to provide reciprocating movement of the bending and 20 cutting means within the housing 14.

Fig. 3 is an exploded cross-sectional view of the housing 14, and is similar to Fig. 2 except that Fig. 3 shows an optical fiber 42 encased in a ceramic ferrule 40 inserted into port 16. To cut a fiber, say a 125 micrometer fiber 42 at a distance of 0.004 inch (100 micrometer) from the fiber ferrule, the exposed fiber itself 25 clearly must be long enough such that the apex 38 of the boot 30 will bend the fiber before it is acted upon by blade 36. Thus, the operator must first strip the sheathing from the glass fiber 42, leaving for example, a 40 mm length of exposed fiber.

Next the exposed fiber should be cleaned with alcohol and the cable inserted and fixed by known techniques into the connector (not shown) so that the 30 exposed fiber 42 extends past the end of the ferrule 40. The fiber 42 encased within the

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ferrule 40 is then inserted into port 16 through opening 18 as shown in Fig. 3, taking care not to break the exposed fiber extending longitudinally outwardly from the ferrule. Further insertion of the cable assembly will stop when the ferrule 40 encounters the shoulder 34.

5           Push button or plunger 22 is pushed once to cleave the fiber as discussed in detail below. The cleaved fiber is then polished at its end with coarse diamond film followed by polishing with fine diamond film.

          The positioning of blade 36 is critical to the cleaving operation. For the fiber assembly described above, it should be positioned approximately 0.004 inch (100  
10   micrometers) below the shoulder ledge 34 so as to act cooperatively with shoulder 34 in achieving a clean cut and providing the desired 0.004 inch length of fiber exposure. This fiber cleaver is suitable for cleaving glass fibers which are fixed in a variety of fiber optic connectors, including ST, SC and FT connectors which are presently those most frequently used.

15           Figs. 4 and 5 show successive stages of the cleaving operation in accordance with the present invention. In Fig. 4, an intermediate stage, the push button is depressed sufficiently to bend fiber 42 by the action thereon of apex or toe 38 of boot 30, thereby inducing tension in the glass fiber 42. Fig. 4 depicts the bent fiber just before cutting by blade 36.

20           Fig. 5 shows the apparatus just after cleaving of fiber 42 by blade 36, the cut end 44 falling away to be caught, optionally, in receptacle 12, not shown in Fig. 5.

          Fig. 6 has been described hereinabove. The support 32 having stop shelf or shoulder 34 is depicted as a separate component in the assembly shown, bolted into the housing 14. However, one skilled in the art will know that this support can be cast  
25   or machined as a unitary component together with the housing 14.

          While the invention has been disclosed herein in connection with certain embodiments and detailed descriptions, it will be clear to one skilled in the art that modification or variations of such details can be made without deviating from the gist of this invention, and such modifications or variations are considered to be within the  
30   scope of the claims hereinbelow.



(57) 청구의 범위

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What is claimed is:

1. A device for cleaving optical fibers comprising:  
a housing assembly having an opening therein for receiving an optical fiber to be cleaved, and housing sequential fiber bending and cutting means reciprocally moveable in a direction transversely and substantially perpendicularly to the longitudinal axis of a fiber inserted into and through said opening,  
said housing assembly optionally having removably connected thereto a receptacle for receiving cut ends of a plurality of cleaved fibers,  
whereby, upon insertion of an optical fiber through said opening and into said housing, and upon actuation of said bending and cutting means, said fiber is sequentially bent and cleaved.
2. The cleaving device of claim 1 wherein said fiber is sheathed within an insulating ferrule such that the fiber extends outwardly from said ferrule exposing a free end thereof, and wherein said opening has a diameter large enough to receive said ferrule, wherein said housing includes therein positioning means disposed in close proximity to said opening, which positioning means prevent the ferrule from insertion into said housing beyond the positioning means, said sequential bending and cutting means being positioned within said housing to provide said bending and cutting leaving a predetermined, exposed length of fiber extending beyond said ferrule after said cutting.
3. The device of claim 2 wherein said positioning means is a stop extending partially over said opening in the housing and providing a shoulder within said housing positioned at a predetermined depth externally from said opening and internally into said housing, beyond which shoulder the ferrule is prevented from further insertion
4. The device of claim 3 wherein said fiber is a glass fiber having a diameter of approximately 125 micrometer and said cutting means is positioned within said

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housing so as to effect cutting approximately 4 one-thousandths inch (100 micrometers) distant along said fiber from said shoulder.

5. The cleaving device of claim 1 wherein said sequential bending and cutting means comprises a boot-shaped pushing head mechanism having an apex or toe and having affixed thereto a cutter, said pushing head being operable to move reciprocally within said housing and adjacent said opening in the direction transversely and substantially perpendicularly to a fiber inserted into and through said opening, the boot toe and cutter being positioned apart from one another along the fiber axis such that, upon movement of said boot toward said fiber, the toe pushes upon and bends the fiber in advance of said cutter contacting and cutting said fiber.

6. The device of claim 5 wherein said cutter is affixed to said boot such that the cutter contacts and cuts said fiber at a predetermined depth externally from said opening into said housing.

7. The device of claim 1 wherein said cutting means is a diamond knife.

8. The device of claim 6 wherein said cutting means is a diamond knife.

9. The device of claim 5 wherein said pushing head is operable by means including a spring-loaded plunger and connecting rod affixed thereto, the plunger reciprocatingly mounted within a cylinder in a side wall of said housing.

10. The device of claim 9 wherein the pushing head is manually operable, in its simplest form by the thumb action of an operator pushing upon said plunger.

11. The device of claim 1 including said receptacle.

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12. The device of claim 1 wherein said housing assembly and receptacle are fabricated of aluminum.

13. The device of claim 1 wherein said housing assembly and receptacle are fabricated of plastic.

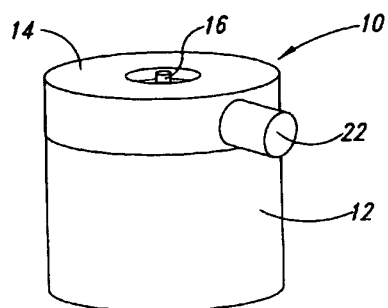
14. The device of claim 13 wherein said plastic is glass filled polycarbonate.

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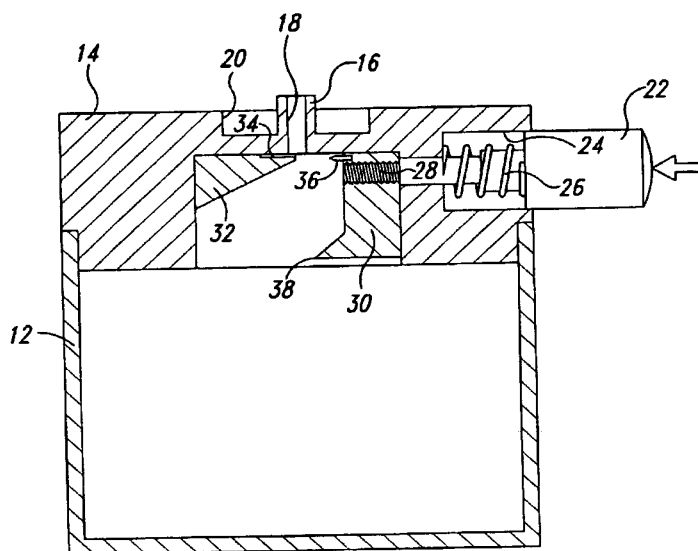
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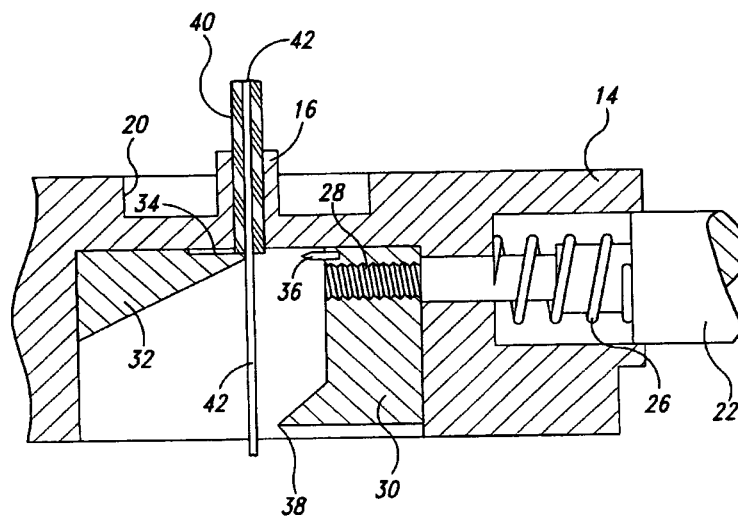
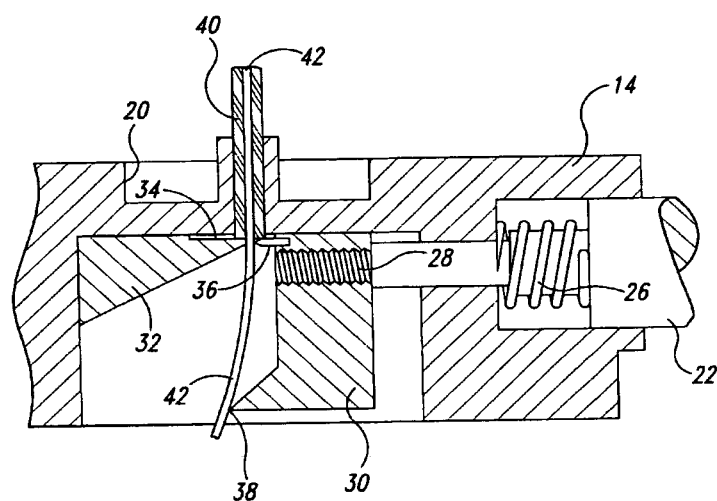


*Fig. 1*



*Fig. 2*

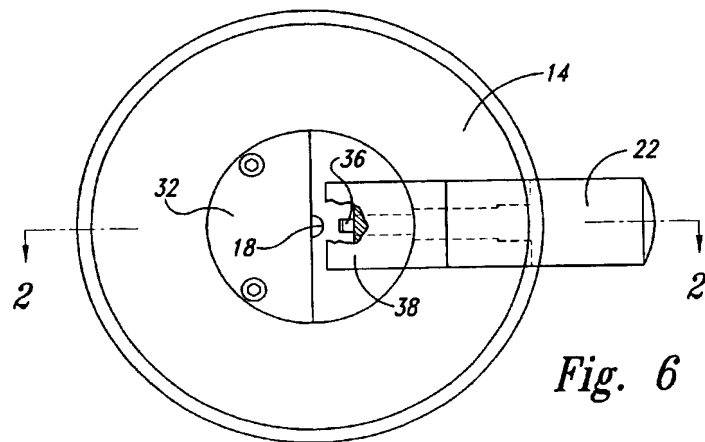
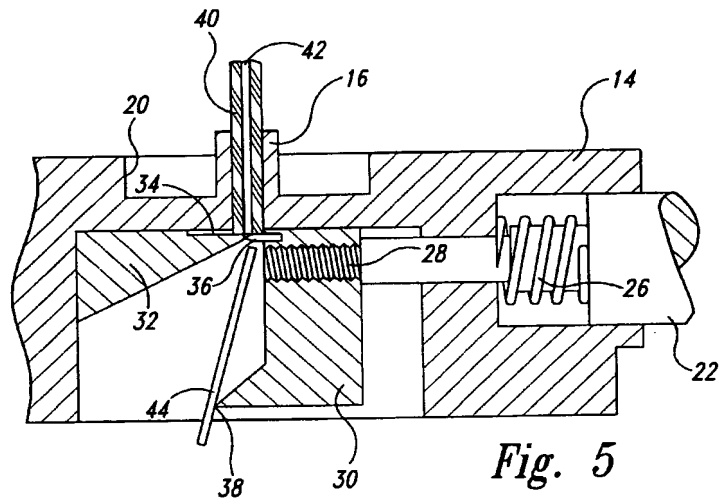
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*Fig. 3**Fig. 4*

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## INTERNATIONAL SEARCH REPORT

Internat.	Application No
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 G02B6/25		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 7 G02B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, PAJ		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 063 672 A (GROIS IGOR ET AL) 12 November 1991 (1991-11-12) abstract; figures 2,3 column 2, line 4 - line 18 column 2, line 31 - line 43 column 3, line 63 - line 66 column 4, line 5 - line 13 column 4, line 23 - line 31 column 4, line 48 - line 51	1-4,7
Y	---	11
X	WO 98 47030 A (MINNESOTA MINING & MFG) 22 October 1998 (1998-10-22) abstract; figures 9A-9C --- -/--	1

<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*A* document member of the same patent family</p>
<p>Date of the actual completion of the international search</p> <p><b>29 January 2001</b></p>	<p>Date of mailing of the international search report</p> <p><b>02/02/2001</b></p>
<p>Name and mailing address of the ISA</p> <p>European Patent Office, P.B. 5018 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 851 epo nl, Fax: (+31-70) 340-3016</p>	<p>Authorized officer</p> <p><b>Jakober, F</b></p>

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# INTERNATIONAL SEARCH REPORT

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PCT/US 00/27441

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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